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ABSTRACT

The study of macroeconomics--the determination and control of aggregative variables such as gross national product, unemployment and inflation--may be facilitated by the use of a computer simulation policy game. An aggregative model of the economy was constructed and programed for a computer and (hypothetical) historical data were generated. The data were then given to students so that they could attempt to make policy decisions which would solve problems of unemployment and inflation in the economy. Variants of the model were used in a number of ways during the past several years--for students in an introductory economics course, for an intermediate macroeconomics course, and for first-year graduate theory students. At the graduate level, a stochastic version of the model has been used with a regression package, and this modification appears to provide an ideal laboratory for the exploration of econometric problems. Most students who have been exposed to the model report that they enjoyed participating in the game and as a result became more interested in their course and that the experience had made the textbook material seem more real and more easily understood. (Author/SH)

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FINAL REPORT

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TEACHING MACROECONOMICS WITH A COMPUTER SIMULATION

F. Trenery Dolbear, Jr.

Brandeis University
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ACKNOWLEDGEMENTS

This document reports on the current status of continuing work on the development of a macroeconomic model, computer programs and teaching exercises for instructional purposes. Professor William Brainard (Yale) Richard Attiyeh (University of California - San Diego), and I have worked together on this project over the past four years. During those years inputs into the game's tradition have been made by a number of individuals. The number has grown too large to reproduce names here but all have at one time or another been associated with the Yale Department of Economics.

SUMMARY

The study of macroeconomics -- the determination and control of aggregative variables such as gross national product, unemployment and inflation -- may be facilitated by the use of a computer simulation policy game. An aggregative model of the economy has been constructed and programmed for a computer and (hypothetical) historical data generated. The data are then given to students who attempt to make policy decisions, e.g. changes in tax rates, which will solve problems of unemployment and inflation in their economy.

It is argued that the game situation provides a favorable learning environment and that it has a favorable impact on the economic content of a macroeconomics course. Students, confronted with a mass of data, find it necessary to use economic theory to make order out of what looks to them -- initially -- like chaos. The usefulness of economic theory becomes apparent. Also, the student's experience as a maker of aggregative economic policy results in a better appreciation of the problems faced by policymakers in real economies.

Although our computer economy is relatively simple, it does incorporate most of the features and relationships thought to exist in real world U.S. economy. Many of the usual classroom policy lessons can be illustrated (taught). Moreover, the game provides an integrated approach to such topics as money, prices, growth, dynamics, policy, which are usually handled in piecemeal fashion by textbooks.

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Background

In recent years there has been a marked increase in the use of classroom games for the teaching of economics.[1] An examination of journals, new books lists, and programs of professional meetings provide objective evidence for this assertion.[2] The reasons for increased pedagogical use of gaming are many and varied, but three major ones come to mind. First, and probably most obvious, is the accessibility of large, high-speed computers, though for many games, and certainly for ours, it is accessibility and not size or speed that's important. Second, games require active involvement and provide continuous feedback which, if the psychologists are right, adds up to a favorable learning situation. In the standard classroom paradigm, note taking -- getting down the instructor's "pearls of wisdom" -- and passively poring over pages of textbooks often become the primary activities of the student. But participation in a game both entices active involvement (because it is fun) and requires involvement (because decisions must be made). Thus a game situation can be expected to be relatively successful in capturing the student's attention and the responses of students who have played our game consistently bears this out. Also, a classroom game provides continuous feedback. The student learns in short order where his decisions achieve their objectives and receives immediate reinforcement for successful performance. We feel this is a great improvement over one or two exams during the semester.

A third advantage of games as a teaching device is that as the subject matter becomes more complex, the connection between the formal content of courses and less structured real world applications becomes more tenuous. There is the hope that participation in a realistic game will lead to success where analytic models which employ algebra or geometry have failed. Basic concepts can be applied in numerous and diverse concrete situations; the game provides the student with the chance to be a user of the theory he is studying.

In our game situation, the model of the economy is not made accessible to the student; rather he is provided with a set of statistical

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1 A classroom game consists of an artificial environment in which the student plays an active role in pursuit of some objective. In our game the environment is an aggregative simulation model of an economy; the student's role is that of a policy-maker trying to avoid unemployment and inflation.

2 Much of the recent activity on the gaming front has been in the area of macroeconomic theory and policy. Our involvement with macroeconomic games dates back to 1966-67, when we developed a policy game and subjected a class of Stanford MBA students to it. The results of that experiment are reported in the May Proceedings of the 1968 American Economic Review. [5]

series on economic variables, such as GNP, unemployment, money supply and taxes, which have been generated from the model by the computer and which represent the past macroeconomic "history" of the economy. The student is then assigned a policy problem, such as the attainment of a targeted GNP or unemployment rate, and provided instruments -- tax rates, open market sales or purchase of bonds -- with which to pursue his target. By examining the "historical" data, the student attempts to determine the behavioral characteristics of the economy. He makes his policy decision and instructs the computer to change the appropriate policy variables. The computer, in turn, determines the reaction of the economy and communicates this back to the student by advancing the economy's statistical record one period. In effect, the student plays in the simulated economy the role of the Council of Economic Advisers or the Federal Reserve Board. He makes his decisions, observes the economy's response, makes a new decision, and so on. He can be assigned one or several goals, over any number of periods. He acquires new knowledge of the system as it reacts to his policy choices, and like an actual policy maker, he must live with the consequences of his own mistakes.

The Revised Model

In our early experience with the game, both model and policy assignments were kept at a relatively simple level. We wanted to illustrate the more complex policy lessons which are typically handled in class and only loosely related to textbook models. Consequently, an effort was made to specify a computer economy which was fairly realistic yet was simple enough to give students a good chance of relating the performance of their economy to their own policy actions. Linear relationships were used where possible and lags kept to a minimum. The main links between successive quarters were the relationships of the price level to past levels of aggregate demand and capital to past investment. Experience has reinforced our belief that simplicity is important; nevertheless, we have added some features to the model and to the play of the game which seem to provide sufficient benefits to be worth their cost in increased complexity. First, we shall quickly summarize our original model, then the revisions in the model and in the way we have used the game.

Roughly speaking, the original computer economy can be described as a textbook "IS-LM" model augmented by a supply side.[3] The IS-LM determination of GNP and the rate of interest included money, aggregate demand (consumption, investment and government spending) and distribution of output (disposable income, taxes, and retained earnings). The supply segment consisted of: 1) a production function with technical change which relates labor force (growing exponentially) and the capital stock (cumulated net investment) to capacity output, 2) Okun's law, which relates unemployment to the utilization of capacity, and 3) a wage-price equation which, similarly, relates the rate of inflation to

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3 For a good statement of the standard textbook IS-LM model see Dernberg and MacDougall. [4]

the utilization of capacity. These last two relationships were roughly consistent with a "Phillips" curve estimated for the U.S. economy. The supply sector was included primarily to provide a consistent way of generating two indicators of the economy's performance -- unemployment and inflation -- but to add realism we set the model in a growth context. Although growth does influence the various components of aggregate demand, growth induced changes in these variables are fairly continuous and predictable in the short run so that their effects are hardly visible to the students' quarter-by-quarter attempts at stabilization.

The basic IS-LM computer economy has been expanded in a number of ways both to make it more realistic and to permit the discussion of a number of economic policy problems and structural features which were not possible in earlier versions of our game. In these cases, as with growth, the realism of the model's behavior is increased but without a marked increase in the difficulty of short-run stabilization.

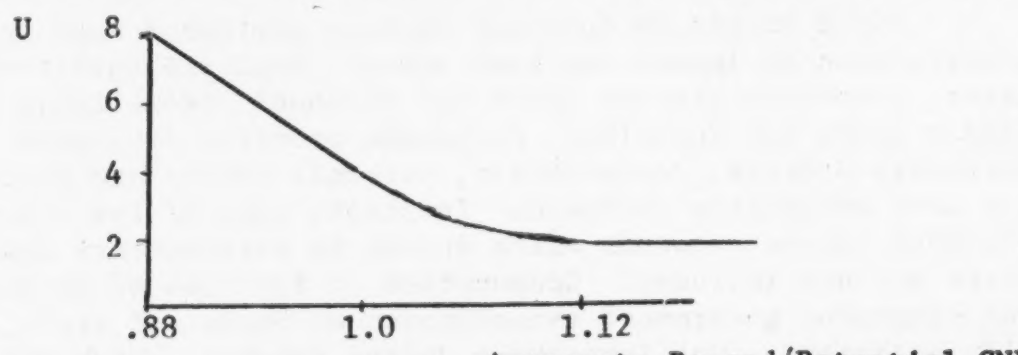
First, in the IS (product market) section a more detailed model of distribution of income has been added. Separate equations for indirect taxes, corporate profits taxes and personal income taxes replace a single linear gross tax function. Corporate profits, dividends, undistributed corporate profits, depreciation, personal income and disposable income are also explicitly included. In short, most of the categories of the national income accounts which appear in introductory and intermediate texts are now included. Consumption (a function of disposable income) and exogenous government expenditures on goods and services are basically unchanged. Our investment demand segment, which was an ad hoc formulation, difficult to justify to students ex post, has been revised to make it theoretically more understandable. In the aggregate, firms are assumed to project an expected GNP (based on the summation of projected transitory and permanent income). For a given labor force and wage/rental ratio, firms compute an optimal capital stock. Then investment demand for any quarter is calculated as a partial adjustment from actual to desired capital stock, plus depreciation and an adjustment for any inventory depletions of the previous quarter.

Second, the LM (money market) curve has been changed from three linear segments to a continuous function. By selecting appropriate parameter values it is possible to move anywhere on a continuum between the textbook extremes of classical or Keynesian regions. Of course the curve is shifted by changes in money or prices. In addition, changes in wealth also affect the curve, a feature usually omitted from the standard textbook treatment. The fixed interest rate (set exogenously) option is preserved to permit instructors to hold a neutral monetary policy while students are concentrating on the IS segment of the model.

The instruments of monetary policy available to the Federal Reserve: open market operations, reserve requirements, and the discount rate have been incorporated into the model. Although the monetary authority is still able to maintain relatively accurate control, the quantity of money is now indirectly, rather than directly influenced by the

authority's behavior. Implicitly, banks are able to vary their holdings of excess reserves or borrowing and thereby change the amount of money that may be supported by a given quantity of unborrowed reserves. This change is not only an improvement in correctly mirroring the endogenous character of money in the real world, but it provides the students with the actual policy instruments at the disposal of the monetary authority.

A third major change involves prices, unemployment and the Phillips curve. Some modifications have been made in the linkage between aggregate demand and the level of unemployment. An Okun's law relationship is applied to unemployment and aggregate demand. This relationship U = 4 + 33 (1 - aggregate demand/potential GNP) holds for aggregate demand/potential GNP ratios which are less than one. For ratios in excess of one, however, a non-linear (quadratic) relationship applies. As aggregate demand increases above potential, successively smaller decreases in U are obtained. Should aggregate demand increase to 12% above potential, a floor would be reached at U equal to 2%. (See diagram.)



After unemployment is determined, Okun's law is applied to relate unemployment back to actual output. Finally in those cases where aggregate demand is not completely satisfied (i.e., U below 4%), a fraction of the unsatisfied demand is added to the next period's investment demand. This represents a combination of back orders and replenishment of inventories.

Turning to price features, the rate of inflation depends on the difference between wage rate and long run productivity growth as well as on the level of excess demand. (There is excess demand if unemployment is less than 4% and, hence, aggregate demand is not fully satisfied by actual output.) The change in wage rates depends (negatively) on a weighted average of past unemployment rates. Also wages are partially adjusted for price expectations. We have given explicit recognition to the role that inflationary expectations play in determining the rate of increase in money wages and the nominal interest rate.[4] Thus we have added an equation which generates an "expected rate of inflation" as a function of actual past rates with exponentially declining weights. The price behavior generated by these new specifications is more reasonable than that of the earlier model. For example, in the original version,

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4 Students who read columns in Newsweek are well aware that the nominal rate of interest may differ from the real rate of the expected rate of inflation.

inflation depended on the current level of employment. Hence it was possible, in response to a swing in the unemployment rate, for inflation to move from zero to 6% and back to zero in successive quarters. The formulation given above introduces a reasonable amount of inertia into price behavior. Similarly, in the new version, the Phillips curve shifts over time as inflationary experience gets built into expectations.

Finally, the growth part of our model still comes from an aggregate production function combining growth in technology, labor and capital to determine potential gross national product. However, our Cobb-Douglas production function has been replaced by a constant elasticity of substitution (CES) production function which provides for more generality. (The Cobb-Douglas is of course a special case of the CES).

The Revised Computer Program

One of the major tasks of this project was to make substantial revisions in the computer program for a number of reasons. First, changes had been made over time in a piecemeal manner so that the programming had become difficult to follow and errors hard to detect. Second, pneumonics were conspicuous by their absence from early generation programs which tended to exacerbate the error problem. Third, the solution techniques required a reduced form for GNP, and moreover a different reduced form equation for each of a number of branches. Thus, when a minor change was made in even a peripheral equation, it often necessitated tedious calculations to see how it would affect each of the GNP reduced form equations. Finally, the solution technique was only able to handle a set of linear equations. As a consequence, lagged values of variables were often used (to preserve linearity) where on theoretical grounds simultaneous values would be more appropriate.

The program has been rewritten to handle all of these objections. A system of pneumonics was designed for parameters and variables which will be easier to comprehend. Changes can now be made with less risk of error, but more important, reprogramming time will be substantially reduced because changes need be made only in the appropriate structural equations. In addition the values of all parameters are input separately so a parameter change does not require a programming change. Finally, the reduced form solution technique has been replaced by an iterative technique.

A solution algorithm has been designed which is very fast and for the range of parameters which make economic sense convergence is no problem. Nonlinearities in the variables are now possible so that our economic judgment about the best way to articulate relationships need not be compromised by computational considerations. Essentially, for any given iteration, the algorithm involves solving the IS curve for rates of interest given two different values of GNP and solving the LM curve for GNP's given two different rates of interest (r). Linear approximations to the IS and LM curves are then obtained and the intersection provides trial solution values for GNP and r. New values of GNP

and r are chosen around the last iteration solution values; in general the intervals shrink iteration to iteration to make the linear approximation more accurate without running the risk of explosion on early iterations where the linear approximation is crude. When solution values have stabilized, the iterative process is ended and last trial values of GNP and r are declared final solution values for the quarter. The actual programming is somewhat more complex than this description would suggest because it is necessary to write in safeguards to make certain the iterations do not attempt to violate corner conditions which would cause the algorithm to fail. For example, the LM curve cannot be solved if a trial interest rate is below the liquidity trap and the IS curve cannot be solved for a rate of interest if the desired capital stock is negative. Also, the determination of wages and prices, expected GNP and price expectations must be included in such a way that interactions do not cause the algorithm to diverge or to become inefficient. To accomplish this the estimates of the IS curve for given GNP's incorporate the effects of those GNP's on expectations and the Phillips curve.

The above discussion concerns programming changes involving the internal workings of the computer economy and methods for changing the economy. We have also made substantial changes in the access to the computer economy. The most significant one is that we are now set up to use the game in a time-sharing context as well as in batch. This means that instead of processing all of the students in one batch submission to the computer which required a large amount of coordination, it is now possible to permit students to play at their own speed and at their own convenience. A quarter of play is as close as the nearest teletype. The close contact between student and computer which the teletype terminal provides has caused us to attempt to introduce some interaction through programmed learning exercises. The computer directs a series of questions at the student designed to explore the economics of the particular session in a logical and orderly way. Moreover, the computer can branch on the responses of students. To the extent that specific policy errors can be associated unambiguously with specific weaknesses in the student's comprehension, advice and reading assignments can be tailored to the needs of the individual student. (See Appendix A for sample.) Unfortunately this work is only in the preliminary stages so we can't report anything about its value but we do have some experiences in the past where we were able to discover specific errors of individual students. The students were very interested to discover the causes of their errors and displayed none of the frustration which sometimes accompanied failure when there was no explanation or guidance.

For our batch processing use of the game we have had some experience at Yale with simple yet surprisingly helpful diagnostics which branch on a student's responses to a series of questions connected with a decision. For example, the student may be asked for a recommendation on the level of government expenditures. In connection with that recommendation he is asked for certain supporting calculations such as an investment and a GNP forecast. The computer then checks to see whether forecasts and policy recommendations are consistent and, if not, offers

some suggestion to the student as to where he might have gone astray. He is also informed whether the size of his policy recommendation caused too much or too little stimulation. In some cases the advice of the student is actually refused (because it was so far off the mark) and a middle of the road change adopted to keep the economy on a steady keel for the next quarter's assignment. Most students have reported these diagnostics to be helpful.

Uses of the Macroeconomic Simulation Game

Variants of the above model have been used in a variety of places and in a variety of ways during the past several years. One version has been used on time-sharing with approximately a hundred and twenty students in an introductory economics course. Another has been used in intermediate macroeconomics courses. A third has been used with first-year graduate theory students. Although we continue to believe that simplicity is a virtue, we also feel that an expansion of the range of policy issues that are analyzed in the context of the game is desirable. Once the students understand the way basic policy instruments work, they find more complicated problems both interesting and feasible.

A number of options have been added. Unemployment and/or inflation can replace output as the argument in the objective function. Congress can be made slow to enact tax legislation. The decision period can be changed from a quarter to several years. In one course some students have investigated the relative performance of rules and discretion over a period of twenty quarters.

It is possible to exhibit in the game context the implications of alternative views of the economy's structure. The instructor can specify different empirical inputs, for example Keynesian or Classical, so that students will become aware of the extent to which optimal policy depends on the nature of various crucial relationships.

At the graduate level we have experimented using a stochastic version of the model. In playing with this version, teams were formed so that at least one member had previously taken, or was currently taking, the basic econometrics course. A regression package was tied into the system; students could run whatever regressions they desired. We found that even with the aid of multiple regressions (ordinary or two-stage least squares) the stochastic version of the model presented about the same level of difficulty for the quantitative types as the non-stochastic model did for the non-econometricians. It also appeared that the model provided an ideal laboratory for the exploration of econometric problems.

Although the game has usually emphasized the use of policy for short-term stabilization objectives, it provides an ideal framework for considering the effect of a sequence of policy actions on the time path of capacity output, income and consumption. Perhaps the greatest gain will come from teaching the economics of growth and stabilization in a

a unified framework.[5] We have had some students analyze the different growth rates of economies operating at different levels of employment. Others have observed different growth rates in economies, operated at the same levels of employment, but with a different fiscal-monetary mix. (They learn the lesson that the combination of easier money and tighter fiscal policy results in a larger share of output going into capacity-increasing investment.)

In addition the real world growth context provides an appreciation to some aspects of stabilization policy often neglected in textbook treatments. Students can perhaps be forgiven if, faithfully following their textbook models, they think an increasing money supply is conclusive evidence that the real world monetary authority is pursuing easy money. Forgiveness is less in order for the student who makes this mistake after playing a series of quarters in our game. Also, the real world necessity of increasing aggregate demand to maintain a given unemployment rate or level of capacity utilization is easily learned from the game; yet it, too, is a point frequently missed by the student who thinks about such problems within the framework of a stationary model.

From these experiences we have learned that there is a high return to careful planning of the sequence of actual problems posed and of the way in which students play the game. Even with simple problems students find it easy to get lost at the early stages. This can be partly overcome by organizing them in teams (two seems to be a good number), but still it appears useful to have a review or catch-up session after two or three exercises.

We have compiled sequences of lesson assignments which have been tested with students and hence instructors will have some assurance that they work. (For a sample see Appendix B.) Of course there is nothing which would prevent an instructor from rolling his own set of lessons. With this in mind we have compiled a list of standard concepts -- in addition to those mentioned above -- which the textbooks attempt to teach and which can be illustrated in our policy game context. For example: the role of theory and models, actual and potential GNP gap, fiscal drag or dividend, full employment surplus, automatic stabilizers, fiscal instruments and their impact, Federal Reserve instruments and their impact, the role of free reserves, linkages between monetary policy and GNP, linkages between aggregate demand and unemployment and prices, the role of expectations, anatomy of fluctuations, difference between real and nominal, effect and causes of growth, conflicting policy goals, value of cooperation between fiscal and monetary policy makers. Not only can these policy lessons be illustrated in the game context; but they can be (ex post) explained in terms of the specific equations and parameters of the model.

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5 The game's relevance to the study of multipliers, model structure, and the major problems of policy-makers are perhaps too obvious to explain in detail. In any event they are discussed in our earlier work. But the growth context provides a less obvious opportunity to exhibit some lessons frequently missed by the student whose training is restricted to a standard textbook.

In the standard textbooks most of these lessons are taught piecemeal; little attempt is made to combine them so as to reveal how the pieces fit together. The textbook discussions of money, prices, growth, dynamics and conflict of policy targets -- all ingredients in the computer simulation -- are usually ancillary to the textbook's income determination models. Thus, many students fail to obtain an integrated understanding of the conventional wisdom from the textbook.[6]

Many students who pass through the typical undergraduate economics course do not acquire an adequate understanding of what economic theory is or how it relates to either economic policy or everyday economic events. But in the game situation the student is forced to use economic theory both to order and make sense of this mass of information and to instruct him on how the policy tools at his command should be used. Under these circumstances, theory will be viewed as a useful tool for understanding economic events rather than as mechanical rules for manipulating a set of abstract relationships all of which appear unrelated to the real world. Thus in addition to providing a favorable learning environment, the game should have a desirable impact on the content of what is taught.

Evaluation

Much of our effort to date has gone into development of more realistic, internally consistent, yet simple models. We have also devoted considerable time to programming and to the design of teaching aids. Stability of the product year to year has not been a trademark of our work; we have been reluctant to settle for the current version when we could see on the horizon a number of changes which would create a richer simulation environment or make the exercises easier to use.

During the period we have been encouraged by the reactions of our students, most of whom have reported to us that 1) they enjoyed participating in the game and as a result had become more interested in the course, and 2) the experience had made the textbook material seem more real and more easily understood. It is obvious that the role playing has also developed in our students a greater appreciation for the problems of real policy makers. Even those few students who expressed reservations about the game experience offered encouragement. They suggested the remedy for their dissatisfactions would be an expansion of the game's activities to make them more integrated with the rest of the course.

All of this positive response does not, however, prove that there has been a noticeable difference in the student's understanding of the subject matter. Although some of the impact of the game will be difficult

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6 At the other extreme of complexity the large econometric models, e.g., the FRB-MIT model or the Wharton model, are designed primarily for research and prediction. Since they involve so much detail (contain so many equations and variables) they are difficult to use for instructional purposes.

to test, e.g., improvement in real world problem solving skills, it would be desirable to run some controlled experiments and apply the standard objective tests to see whether any differences can be detected. Unfortunately we have been unable to run such tests largely because we have not had, for example, two groups of homogeneous students, taught by the same instructor, same textbook, etc. We are looking for such an experimental setting in the future. In addition (but perhaps irrelevant because of the above constraint), since we have been encouraged by early returns we have devoted much of our energies to making improvements which meant we have not until recently had a polished model which we wanted to submit to tests.

We are able, however, to report that a controlled experiment is now in progress. Professor William Nordhaus at Yale is currently (academic year 1971-72) using a version of the policy game in one of two sections of Yale's undergraduate macroeconomics course. He has been careful to observe all the usual rules for a controlled experiment. It is premature to report any results but Nordhaus has informed me that the game section displays the usual enthusiasm. He is not able to tell yet whether or not there is any difference in performance between sections.

Recommendations

Although we are unable to provide formal evaluation results, we can suggest to other instructors that playing our macroeconomic simulation game can be viewed as supplemental to a textbook approach. Thus its use has a low opportunity cost in terms of replacing usual subject matter and it offers the enticing dividend that students like it and that some of this enthusiasm is transferrable to other parts of the course. For our part we will be willing to supply instructors at other universities with copies of our program and a sample of exercises. All we ask in return is a report on their experiences.

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[5] F. T. Dolbear, Jr., R. Attiyeh and W. C. Brainard, "A Simulation Policy Game for Teaching Macroeconomics," American Economic Review papers and proceedings, Vol. LVIII, No. 2, May 1968 [first generation of model and exercises described in this report].

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APPENDIX A

Sample Programmed Learning Exercise*

DECISION 1.

1. It is assumed that you have already read the material for Decision 1. in your manual. If you have, type YES. If you have not, type NO.

   ?

2. What GNP for next quarter do you think will result if the President signs the Public Works bill?

   ?

3. What is your forecast for GNP if the President vetoes the bill?

   ?

4. Do you recommend that the President sign the bill? (YES or NO)

   ?

5. The President has received your answers. He wants to be sure he has them correctly. As he understands it you think GNP for next quarter will be _____ if he signs and _____ _____ if he vetoes the bill and you recommend that he _____ the bill. Are these answers correct? (YES or NO)

   ?

5.1. [If NO . . . resubmit answers]

6. [Only if multipliers are different . . .
One of the President's White House advisers has noticed that you think the $5 billion increase in Government spending (in the event of a veto) will result in a $_____ billion increase in GNP, while the $13 billion increase in Governement spending (if the President signs) will result in an increase of $_____ billion. The President wants to know if that is what you believe. Is it? (YES or NO)

   ?

6.1. [If NO . . .
Do you want to change your answers? (YES or NO)

* This appendix was written by Richard Attiyeh.

6.1.1. [If YES . . . resubmit answers]

?

7. [Only if forecast is inconsistent with recommendation . . . The President has noticed that your forecast GNP if he (signs/ vetoes) the bill is closer to the target, yet you recommend that he (veto/sign) the bill. He does not understand this and wants to know if you want to change your recommendation. Do you? (YES or NO)

?

7.1 [If YES . . . Please type your new recommendation.]

?

8. [RUN PROGRAM, PRES. VETOES, PRINT ECON INDICATORS]

9.1. [If REC. WAS VETO . . .
As you can see from the economic indicator the President has taken your advice.]

9.2. [If REC. WAS SIGN . . .
The President's concern over public reaction to a higher budget deficit led the President to reject your advice and to make the political decision to veto. Your forecast GNP in the event of a veto was _____ which turned out to be _____.]

[IF $|Y_f - Y_a|$ >8 . . . far from actual GNP]

[IF $|Y_f - Y_a|$ >4, <8 . . . not too far from actual GNP]

[IF $|Y_f - Y_a|$ <4 . . . quite close to actual GNP]

10. A Cabinet meeting has been scheduled to discuss the current economic situation. One of the points the President wants to bring up is the accuracy of your forecast. He wants to know whether there were any periods in recent history which provided you with an empirical basis for your forecast. Have you studied your history?

?

10.1. [If NO . . . You should sign off.]

10.2. [If YES . . . Good. Do you believe there were periods in the recent past that were helpful in preparing your forecast for last period? (YES or NO)]

?

14.

10.2.1. [If NO . . . What about periods _____? Before you sign on to record your next decision you should study your economy's history. This should be of help to you.]

10.2.2. [If YES . . . Which ones? (List the appropriate quarters separated by commas.)]

?

10.2,2.1. [Compare these with a good list and if there is some agreement but not perfect agreement . . . Good, but what about periods _____?

10.2.2.2. [If no agreement . . . What about periods _____? It might be a good idea for you to analyze the economic developments during those periods.]

10.2.2.3. [If perfect agreement . . . Very good.]

11. Did you base your decision at least in part on your analysis of this history? (YES or NO)

?

11.1 [If YES . . . Good.]

11.2. [If NO . . . If you did, you would find this helpful.]

12. [Only IF $|Y_f - Y_a| > 8$: The President also wants to know why your forecast was so far off the mark. Did you give careful thought to the President's questions? (YES or NO)

?

12.1. [If NO . . . You should sign off and plan to put more work into the planning of your decisions.]

12.2. [If YES and $Y_f - Y_a < -8$ . . . In making your forecast did you consider whether the increase in Y resulting from the increase in G would cause other components of aggregate demand (i.e., C and I) to increase as well? (YES or NO)

?

12.2.1. [If YES . . . Good.]

12.2.2. [If NO . . . That would be a good thing to think about.]

13. If G increases and Y increases what do you think would happen to C as a result? (INCREASE, DECREASE, or NO CHANGE.)

13.1. [If INCREASE . . . Good.]

13.2. [If DECREASE or NO CHANGE . . . No. It would increase because as incomes increase, households are likely to spend more.]

14. What effect would this increase in C have on the level of income itself? (HIGHER, LOWER, UNCHANGED.)

?

14.1. [If HIGHER . . . Right.

14.2. [If LOWER or UNCHANGED . . . No. The increase in C would itself lead to a further increase in Y.]

14.1. and 14.2. This explains why an increase in G of 5 resulted in an increase in Y that was greater than 5. (A similar effect operates through I. The increase in G leads to an increase in Y and therefore I and consequently further increase in Y.) This is what is meant by the multiplier effect of an autonomous increase in spending.

14.1.1. [If HIGHER and if $Y_f - Y_a > 8$:
When making your forecast you obviously realized that an increase in Y resulting from an increase in G would lead to increases in other components of aggregate demand (C and I) which in turn would lead to further increases in Y. Is that right? (YES or NO)

?

14.1.1.1. [If NO . . . You have studied the history of this economy. You gave careful thought to the President's questions. You did not realize why an increase in G would have a multiplied effect on Y. It is hard to see where you went wrong. The President believes you should seek the assistance of an economics instructor to find the error of your ways before you advise him again. Please sign off.]

14.1.1.2. [If YES . . . Good, but it appears you over estimated the responsiveness of C and I to changes in Y. You should sign off and try to figure out why you thought the multiplier was so high. You should try to reconcile your analysis of the way the multiplier effect works with the empirical facts of life for your economy. Hint: The effect of an increase in Y on C is not just the MPC out of disposable income times Y. Rather it is equal to MPC out of disposable income times (Y - other leakages). Retained earnings and taxes are examples of other leakages.]

16.

14.2.1. [If LOWER, UNCHANGED, or if $Y_f - Y_a < 8$ . . .

The President also wants to know whether your forecasting ability can be improved. When making your forecast you obviously realized that an increase in Y resulting from an increase in G would lead to increases in other components of aggegate demand (C and I) which in turn would lead to further increases in Y. Is that right? (YES or NO)

?

14.2.1.1. [If NO . . . You should sign off and spend some time prior to making your next decision thinking about the relationship between the multiplier concept and what happened in your economy last period and previous periods. To do well as an economic advisor you must reconcile empirical evidence obtained from your economy's history with your understanding of how the economy functions based on economic theory.]

14.2.1.2. [If YES . . . Good, but you did not estimate accurately how responsive C and I would be to changes in Y.

APPENDIX B

Sample Assignment Set

Congratulations. You have just been named chairman of the Council of Economic Advisers for the sovereign state of Econoland. Econoland is an unusual land in that time can be speeded up or slowed down by the stroke of a pen (or the tap of a teletype). The structure of its economy is not so unusual, however. It bears a striking similarity to the economy of the U.S. Thus economists who are used to thinking about the U.S. economy usually find they can transfer a good deal of their knowledge to Econoland.

During the next few weeks you will be asked to make specific policy recommendations designed to "manage" the economy toward certain (usually specified) goals. Like real world economists, you will not know the details of the economic systems, but you will have at your disposal certain economic data which you may find of assistance in carrying out your various assignments. Like real economists you may (will?) make errors in your recommendations; both you and Econoland will be forced to live with those errors. Finally, you should recognize at the outset that there will frequently be no foolproof technique designed to produce right answers. (There may be better answers, or more logical answers but you must learn, as economists before you have learned, that textbook techniques cannot be expected to give definitive answers--particularly if you're consulting the wrong textbook.)

You will probably find it helpful to study the attached data for Econoland for the past 20 quarters (5 years). Students of Econoland have recorded the following additional information which you may find helpful.

1. There was a small cut in personal income tax rates effective at the beginning of quarter 5. At that time there was also a decline in the level of certain types of investment spending which is now believed to be permanent.

2. A 10% tax surcharge (i.e., an increase in normal tax liabilities of 10%) was levied effective midway through quarter 11. This surcharge was reduced to 5% at the beginning of quarter 19.

3. The Central Bank's discount rate was 4 1/2% for the first 9 quarters but was increased to 5.4% at the beginning of quarter 10 and then to 6% at the beginning of quarter 14. After quarter 19, the rate was lowered to 5.8%.

4. Reserve requirements have been 15% throughout the period.

ECONOLAND
NATIONAL INCOME ACCOUNTS

QTR	Y	C	I	G	T	D	UCP	DEPRE	TI	TC	TP	CP	DIVD
1	536.4	314.2	87.2	135.0	126.9	336.9	19.7	52.9	22.	34.	71.	68.0	14.3
2	539.7	316.3	86.8	136.7	127.7	339.1	19.7	53.2	22.	34.	72.	68.4	14.5
3	542.2	318.2	86.1	138.0	128.2	341.2	19.4	53.5	22.	34.	72.	68.3	14.8
4	546.5	320.4	86.3	139.7	129.3	343.7	19.7	53.8	22.	35.	73.	69.3	15.0
5	566.4	333.2	86.7	146.5	129.6	357.8	24.9	54.1	22.	40.	67.	80.7	15.5
6	571.0	336.0	86.7	148.2	130.8	360.9	24.9	54.4	22.	41.	68.	81.6	15.9
7	575.5	338.9	88.9	147.7	132.0	364.0	24.8	54.6	22.	41.	69.	82.3	16.3
8	581.1	341.9	91.3	147.9	133.6	367.4	25.2	54.9	22.	42.	70.	83.8	16.7
9	587.9	345.3	92.3	150.3	135.6	371.2	25.9	55.3	22.	43.	71.	86.1	17.2
10	592.4	348.2	92.4	151.8	136.7	374.3	25.8	55.6	22.	43.	71.	86.7	17.6
11	589.8	343.2	96.5	150.1	139.8	368.7	25.4	55.9	22.	43.	75.	86.7	17.9
12	591.2	339.1	100.7	151.4	144.4	364.1	26.4	56.3	22.	45.	78.	89.4	18.3
13	597.0	342.0	103.7	151.2	146.2	367.3	26.8	56.7	22.	46.	79.	91.0	18.7
14	600.7	344.6	106.9	149.3	147.1	370.1	26.5	57.1	22.	46.	80.	91.1	19.1
15	606.2	347.4	110.8	148.0	148.7	373.2	26.8	57.5	22.	46.	80.	92.4	19.5
16	608.4	349.6	111.7	147.0	148.8	375.7	25.9	58.0	22.	46.	81.	91.3	19.8
17	605.3	350.8	109.9	144.6	146.7	376.9	23.3	58.4	22.	43.	81.	86.4	19.9
18	602.7	351.8	109.2	141.6	144.7	378.0	21.0	58.9	22.	41.	82.	82.0	20.0
19	615.1	361.9	112.5	140.7	144.4	389.2	22.2	59.3	22.	42.	80.	84.5	20.1
20	614.3	363.3	110.4	140.6	143.2	390.7	20.7	59.8	22.	41.	80.	81.5	20.1

	FINANCIAL					EMPLOYMENT--PRICE				OTHER	
QTR	R	M	H	F	DRATE	U	PR	WGR	P	GD	L
1	5.35	199.9	30.6	0.67	4.50	4.38	3.10	4.79	1.008	202.0	65.2
2	5.61	199.8	30.5	0.51	4.50	4.43	2.80	4.47	1.015	204.3	65.4
3	5.85	199.8	30.3	0.36	4.50	4.53	2.55	4.20	1.021	206.8	65.6
4	6.02	201.1	30.4	0.26	4.50	4.53	2.49	4.15	1.028	209.5	65.8
5	6.83	201.4	30.0	-0.25	4.50	3.61	2.94	4.92	1.035	213.9	66.0
6	7.24	201.8	29.8	-0.51	4.50	3.60	3.47	5.51	1.044	218.4	66.2
7	7.26	205.6	30.3	-0.53	4.50	3.59	3.94	5.97	1.054	222.6	66.4
8	7.27	209.8	30.9	-0.55	4.50	3.52	4.07	6.12	1.065	226.4	66.6
9	7.53	212.7	31.2	-0.73	4.50	3.39	4.29	6.38	1.077	230.3	66.8
10	7.92	214.0	31.5	-0.57	5.40	3.40	4.48	6.56	1.089	234.4	67.0
11	7.40	220.2	32.8	-0.23	5.40	3.81	4.31	6.23	1.100	237.3	67.2
12	6.89	228.0	34.3	0.13	5.40	3.99	3.98	5.83	1.111	239.2	67.4
13	6.73	234.1	35.4	0.24	5.40	3.94	3.77	5.65	1.122	240.6	67.6
14	6.53	240.3	36.8	0.73	6.00	4.00	3.71	5.57	1.132	241.2	67.8
15	6.31	247.4	38.0	0.91	6.00	3.97	3.72	5.60	1.143	241.0	68.0
16	6.26	251.7	38.7	0.97	6.00	4.13	3.63	5.46	1.153	240.5	68.2
17	6.27	253.5	39.0	0.97	6.00	4.57	3.34	5.01	1.163	239.9	68.4
18	6.14	256.7	39.6	1.08	6.00	4.98	2.90	4.43	1.171	239.0	68.6
19	6.06	264.4	40.7	1.06	5.80	4.58	2.67	4.39	1.179	237.9	68.8
20	6.08	266.4	41.0	1.06	5.80	4.89	2.58	4.20	1.187	237.1	69.0

DEFINITIONS*

National Income Accounts

Y = Gross National Product
C = Consumption
I = Gross Investment
G = Government Expenditures on Goods and Services
T = Net Tax Receipts
D = Disposable Income
UCP = Undistributed Corporate Profits
DEPRE = Depreciation
TI = Indirect Taxes
TC = Corporate Income Taxes
TP = Personal Income Taxes
CP = Corporate Profits (before taxes)
DIVD = Dividends

All of the above are reported in billions of dollars in quarter 0 prices (i.e., real)

Financial

R = Rate of Interest (per cent)
M = Money Supply
H = Reserves of the Banking System (High Powered Money)
F = Free Reserves (= Excess Reserves - Borrowed Reserves)
DRATE = Discount Rate

M, H and F are reported in billions of dollars in current quarter prices (i.e., nominal)

Employment--Price

U = Unemployment Rate (per cent)
PR = Rate of change of Prices (per cent)
WGR = Rate of change of Wages (per cent)
P = Price Level

Other

GD = Government Debt (billions of dollars in quarter 0 prices)
L = Labor Population (in millions)

* All "flow" or "rate" variables are at annual rates.

Assignment No. 1

It's Economic Report season in Econoland. You have been asked to mediate some disputes among members of your staff. They are agreed on a GNP of 625 at the end of quarter 21. But they can't decide whether they should put their forecast (or target) in terms of real or nominal dollars. [Reference: Economic Report of the President 1971, Ch. 2 (1065 and all that).]

1. What is the difference between forecast GNP and target GNP?

2. How would you predict real GNP? nominal GNP? Which do you think would be more accurate?

Because of economies which will result from a speed-up in the rate of troop withdrawals, it now appears likely that government spending will be held at its quarter 20 level and consequently--in the absence of other policy changes--GNP for quarter 21 will be unchanged from its quarter 20 level. In an attempt to reach a GNP of 625, the President has asked you to propose a change in the personal tax exemption. (Tax exemption = exemption of personal income from taxation per member of the Labor Population.)

3. Explain how increased tax exemptions would affect GNP. How will the change affect taxes? How will the change in taxes affect GNP?

4. Explain how you arrived at your estimate of the required change in taxes.

5. Provide an estimate of tax yield and of consumption spending in constant (quarter 1) dollars.

The central bank's short-run plans are to expand bank reserves by an amount necessary to hold interest rates at their quarter 20 level; this is sometimes called a "neutral monetary policy."

Assignment No. 2

The President would like to continue the recovery begun in quarter 21. Some tax legislation which is about to emerge from Committee will, he feels, provide the necessary encouragement to reach a new target of 640. There will be no change in government spending and the Central Bank will hold the rate of interest constant.

1. What change in tax rates would you recommend?

2. Predict nominal and real (quarter 0 prices) tax revenues for quarter 22. Explain how you arrived at your prediction.

3. In the past two quarters tax policy has involved changes in exemptions and rates. In earlier quarters tax policy involved a surcharge. What relationship, if any, is there between changes in the surcharge and changes in exemptions or rates?

4. Some Congressmen have been concerned about the size of the government deficit. Would you explain how to predict this deficit and provide an estimate. How much of this deficit can be attributed to your change in tax rates?

5. The debate about deficits has triggered some discussion about the full employment surplus. Explain full employment surplus. Provide an estimate--after your tax rate change.

Assignment No. 3.

Continued recovery from the recent recession is again the order of the day for quarter number 23. The President would like to achieve a GNP level of 650. Although many people favor frugality on the part of the government's claim on goods and services, it looks as if it will be impossible to hold the line. Government spending is expected to increase by 10. The central bank has announced that it will attempt once again to hold the line on interest rates--at 6%. Since relationships between the Administration and Capitol Hill have never been more cordial, it appears likely that any form of tax change can be legislated.

1. What change in tax exemptions, tax rates, or tax surcharge would you recommend? Be careful to be unambiguous about what you want to do. Is it of any consequence which instrument you use?

2. Provide an explicit (algebraic) estimate of how you think taxes are determined in Econoland.

3. Predict, for GNP = 650, the levels (in real dollars) of T, UCP, D, C, and I. Show your calculations.

Assignment No. 4

After the Administration's abortive attempt to pick the appropriate tax rate in quarter 22, the Central Bank has decided to exert its independence. For quarter 24 it will attempt to stabilize the money supply (holding it to its quarter 23 level) and of course to discontinue its policy of holding the rate of interest constant. When asked the rationale for this shift in policy, Central Bank press officials answered, "No comment." The target GNP in quarter 24 has been set at 660. G will be held at its quarter 23 level.

1. What change in tax exemptions would you recommend? Explain (show your analysis).

22.

2. How (if at all) does your policy differ from what it would have been if the Central Bank had pledged itself to hold r constant?

3. Predict r for GNP 660.

4. What effect (if any) will the change in Central Bank policy have on mix of C and I?

Assignment No. 5

The President has been generally pleased with the steady progress of the economy and would like to extend the string of quarters of uninterrupted expansion into quarter 25. The Central Bank has this time announced it will stabilize bank reserves--at their quarter 24 level. Government spending will not change. The target GNP will be 675.

1. What change in tax rates would you recommend?

2. How, if at all, is this problem different from quarter 24? Predict M.

3. Predict r for GNP of 675.

4. Predict C, I, and G for GNP of 675. (N.B. It does not make sense to predict one as a residual. The idea is to have three sources of aggregate demand which add to 675.)

Assignment No. 6

The President has decided that the capricious policy making at the Central Bank has gone unchallenged for too long. He has arranged a meeting with the head of the bank and he intends to try to instruct him on what the level of reserves for quarter 26 should be. At the same time the Congress is outraged to learn that the President intends to interfere with a Congressionally legislated independent monetary authority. In retaliation Congress has made known there is little prospect for any new tax legislation or change in government spending. The President wants to increase GNP to 685.

1. What change in reserves do you recommend?

2. Explicitly, how will your policy work?

3. Predict: a) I
   b) U
   c) PR

SPECIAL BULLETIN

The research department at Econoland Central Bank has received some inquiries concerning reserves of the banking system (H) and free reserves (F). They would like to clarify the definitions. Member banks hold some of their deposits at the Central Bank. The sum of these Central Bank deposits over all banks is the quantity (H). The member banks are permitted to borrow additional reserves (B) at the Central Bank discount window. Required reserves are, as you know, 15% of the money supply (M).

Excess reserves (ER) are defined as: $ER = [H + B] - .15M$

Free reserves (F) are then: $F = ER - B$

One of the problems the Central Bank research department gives top priority is the behavior of member banks at the discount window, or, what is the same thing, the study of the factors which determine free reserves. They would, of course, be grateful for any help you might be able to offer.

Assignment No. 7

Although relations between the Administration and Capitol Hill have warmed somewhat, Capitol Hill spokesmen have reminded the President that new tax legislation for five successive quarters was an unprecedented departure from traditional methods. Rank and file Congressmen are dissatisfied with the new ways of doing business. Many of them have been unable to get back to their districts as often as they would like because of the demanding Congressional schedule which they attribute to lengthy debates on tax policy. (More than a few feel they are long overdue on a fishing and hunting expedition.)

It appears likely that quarter 27 will be the last quarter for new tax legislation for at least three quarters (i.e., before quarter 30). However, Congressional leaders will be receptive to tax laws designed to take effect in each of quarters 27, 28, 29. In other words the Administration must set tax laws <u>now</u> for each quarter -- 27, 28 and 29. Of course the Central Bank will be able to change reserves in any and all of the quarters.

A recent study on national priorities has asked for an expansion of government spending on cities of 5 in quarter 27, and an additional 5 in quarter 28. Although the spending for quarter 27 is set, it is by no means certain that additional spending in quarter 28 will be approved. And the question won't be resolved until after your tax legislation is put to bed.

Econoland critics have been arguing in voices which get louder every quarter that the Administration has given too much attention to setting targets on GNP and that more attention should be paid to

unemployment and inflation which are more meaningful indicators of the state of the economy. The President, who generally heeds the advice of his critics, has decided to attempt to reach an unemployment rate of 3% by quarter 28 and to hold it at that level in quarter 29. He would like to hold the rate of inflation below 4%. Finally, ill winds which have been blowing in international financial markets have resulted in widespread opinion that the rate of interest should be no lower than 6.3%. Concerns for high investment as an instrument for high economic growth, however, dictate that the interest rate should be no higher than necessary to ward off an international monetary crisis.

1. What is your tax program for quarters 27, 28 and 29? (You may use any of the three instruments.)

2. How would you change the reserves of the banking system for quarter 27?

3. Describe the process by which you reached your decision.

Assignment No. 8

New legislation on cities is about to emerge from Committee and it appears virtually certain that government spending will increase by 3 in quarter 28. Your targets were outlined in quarter 27's assignment.

1. How would you change the reserves of the banking system for quarter 28?

2. Suppose you were permitted to change the discount rate or reserve requirements. How would those instruments work?

Sample Computer Output

Quarter 24 -- Econoland -- Team No. 1

National Income Accounts			Financial	Employment-Price
C = 39Ø.Ø	D = 42Ø.2	TI = 23.2	R = 6.Ø8	U = 3.36
I = 124.8	UCP = 31.6	TC = 53.2	M =297.1	PR = 4.27
G = 15Ø.6	DEPRE= 61.7	TP = 75.6	H = 45.8	WGR = 6.54
	T = 151.9	CP = 1Ø6.4	F = 1.18	P = 1.226
----	-----	DIVD = 21.6	DRATE = 5.8Ø	L =69.85
Y = 665.4	Y = 665.4	GD = 237.7		

EXEMP = 1.ØØØ CPTR = Ø.5ØØ PTR = Ø.164 STR = Ø.Ø3Ø SUR = Ø.Ø5Ø